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Description

This invention relates to combined heat and power systems for buildings.

Such systems comprise a prime mover such as a natural gas-powered internal combustion engine driving an electrical generator and a heat recovery unit recovering waste heat from the engine exhaust and cooling system and possibly the generator and applying such heat to building heating. The generator is used in parallel with external e.g. mains supply to power electrical equipment in the building. The objective of such systems is heating fuel/electricity cost savings on the assumption that even though not all of the fuel consumed by the system is applied directly to building heating, such heat as is not so applied is applied instead to the generation of electricity which is consumed in the building in performing useful tasks and such consumption generally speaking generates heat so that the fuel heats the building indirectly. The heat may be generated deliberately, as by radiant electric heaters or fan heaters, or it may be generated by incandescent lighting or as an unavoidable by-product, as it were, of the consumption of electric power in for example electric motors or electronic equipment, or simply as transmission losses in the building's wiring.

At least to some extent, therefore, the electricity produced can be regarded as free, although the capital cost of the generating plant as well as the running and maintenance costs have to be reckoned with. Account has to be taken, also, of the heating effect of the electricity consumed in a normal building in the absence of a combined heat and power system, which must reduce the amount of fuel needed to be consumed for heating the building.

Nevertheless, substantial advantages and cost savings could accrue from building combined heat and power systems, although for various reasons such systems proposed hitherto have not in general been attractive enough to justify the trouble and expense of installation and operation.

The article "Cogeneration System supplies restaurant power" by Robert J. Lawrie in the publication EC & M of August, 1985 describes a cogeneration system in which water heating and electrical power for a restaurant are obtained from a gas-powered generator. The generator is controlled by a local mini-computer and this is connected to a remote, central host computer which monitors overall operation and is used to input adjustments to control parameters.

The article "Computer Controlled Remote Engine Operation for Cogeneration" by Bruce Wadham in the publication Diesel Progress North America of February, 1985 also describes a cogeneration system in which a computer-controlled generator is connected on-line to a remote, host computer. The host computer is used for long term data storage and the production of periodic reports. There is also reference to the host computer being used for complete operation, monitoring and maintenance.

The present invention provides improved combined heat and power systems for buildings which can have substantially improved performance, ease of operation and lower installation and running costs than existing proposed systems.

According to the invention therefore there is provided a combined heat and power network comprising a plurality of individual combined heat and power systems for buildings connected to a common remote control arrangement, wherein:

each said system comprises a prime mover drivingly connected to an electrical generator adapted to provide building electrical power, a heat recovery arrangement connected to the prime mover recovering heat therefrom and adapted to provide building heating, and a local control arrangement adapted automatically to control the prime mover in response to heating demand;

each said local control arrangement includes a memory and is adapted to monitor the condition of elements of the respective system and to store variables relating thereto in said memory;

and each local control arrangement is adapted automatically to shut down the respective system in response to abnormal operating conditions indicated by said variables;

the remote control arrangement being adapted to receive information representing said stored variables from the respective local control arrangements and to evaluate said information so as to derive performance data and schedule servicing for the systems;

characterised in that the local control arrangement is adapted automatically to attempt restart of the system following said shut down, and said remote control arrangement is adapted to receive messages from said local control arrangements following abandonment of such atempted re-start for evaluation and response by said remote control arrangement.

The generator may be adapted to be synchronised to an external a.c. electrical power supply.

The local control arrangement may be adapted automatically to shut down the prime mover in the event building heat demand falls below a predetermined level.

Each system may be adapted to provide standby power in the event of external power supply interruption by the control arrangement detecting such condition and automatically starting up the prime mover and establishing connection of the

generator to power the building.

Each system may be adapted to respond independently to building power demand and building heat demand. Each system may be operable to supply up to its maximum rated power output and simultaneously to supply less than the entire heat output associated therewith to building heating.

Each system may be adapted for connection to the remote control arrangement by modem means and a telephone link. Each local control arrangement may be adapted to control the respective said system according to rules which can be changed by signals from the remote control arrangement.

The said elements which each said local control arrangement is adapted to monitor may be such, for example, as lubricating oil condition and spark plug condition, where the prime mover relies on such elements.

Each said local control arrangement may also be adapted to monitor operating variables of the system, such, for example, as temperatures of the system, such as water temperatures associated with building heating and prime mover exhaust system temperature, and flow rates of fluids used in the system, such as fuel flow rate and flow rates of water used to circulate building heat.

Each said local control arrangement may also be adapted to monitor electrical power output by monitoring e.g. power factor, phase voltage and current and frequency.

Each said local control arrangement may be adapted to monitor the status of electrical control circuits of the system.

Each said local control arrangement may provide engine governing and mains synchronisation for said prime mover/generator arrangement.

The invention will now be described further by way of example only and with reference to the single figure of the accompanying drawing, which is a diagrammatic illustration of one form of a combined building heat and power network according to the invention.

The figure illustrates a combined heat and power system 10 for a building comprising a prime mover 11 - a gas engine driven from natural or town or propane or other gas - drivingly connected to an electrical generator 12 adapted to provide building electrical power and a heat recovery arrangement 13 connected to the engine 11 recovering heat therefrom and adapted to provide building heating, and comprising a control arrangement 14 adapted automatically to control the engine 11 in response to heating demand.

The gas - from mains supply pipe 15 via the usual meter 16 - would ordinarily be used to heat water, for building heat circulation through radiators, in a conventional boiler. Instead, in the combined heat and power system, the gas is burned in the engine 11 and produces useful electricity in the generator 12, the hot exhaust gas and cooling water from the engine 11 being used to heat circulatory water in the heat recovery arrangement 13.

A typical system would produce up to 40KW of 3-phase electricity and around 75KW of high grade hot water at an outlet temperature from the heat recovery arrangement of up to 85°C, depending on the incoming water temperature and flow rate. The use of a condensing heat exchanger, depending on the availability of a suitable low temperature water supply, could increase heat recovery by some 5-10 KW.

The generator 12 is self-exciting, so that it is not dependent on mains electricity supply for restarting, but is adapted to be synchronised with the 3-phase mains supply 17, which has the usual meter 18. Ordinarily, the mains supply 17 would be the sole source of electrical power for the building, although stand-by generators are often provided, which cut in or which can be manually started in the event of an interruption in the mains supply. However, with a combined heat and power system, the mains supply 17 is supplemented or replaced by the generator 12 of the system, replacing expensive power station-generated electricity with electricity generated less expensively on-site.

Clearly, instead of generating 3-phase current, single phase may be generated if this is what will be used in the building; and, of course, the choice of voltage and frequency will be made according to the available mains supply, or otherwise, as required.

The control arrangement 14 is adapted automatically to shut down and re-start the engine 11 and reconnect the generator 12 to power the building. The engine 11 can be progressively shut down automatically in the event building heat demand falls below a predetermined level (unless, of course, the system is being relied upon to replace mains power). The engine 11 can also be shut down automatically in the event of abnormal operating conditions - mains failure could of course be such a condition unless the system is operating as a stand-by generator, in which case the control arrangement detects a mains interruption and automatically starts up the engine 11 and establishes connection of the generator 12 to power the building. This will take place in these circumstances even though the bulding may not be calling for heat - the exhaust heat can then, however, be vented to atmosphere.

The system can also be adapted to respond more generally independently to building power demand and heat demand - thus, for example, in times of high heat demand but low power demand

such for example as the heating up of the building before the start of a working week most of the energy could be output as heat energy by, for instance, connecting the generator output to a resistive load in the building heating water circuit.

The system has connection means in the form of a modem 19 adapted to connect the system via a telephone link 20 to a remote control arrangement 21 adapted to communicate with a plurality of such systems. The control arrangement 14 is adapted to control the system according to rules - normally embodied in a program for a computer of the control arrangment - which can be changed by signals from the remote control arrangement 21. The control arrangement 14 is adapted to supply to the remote control arrangement 21 information about the system.

Thus for example the control arrangement 14 can supply data about building heating water temperatures and flow rates, heating demands and power demands. Other systems in a network with a common remote control arrangement 21 can supply similar information. From the totality of this information input to the remote control arrangment 21 can be evaluated improved control algorithms such for example as for desired operating power levels at different heating loads and power loads to optimise efficiency.

Very importantly, the local or on-site control arrangement 14 is adapted to monitor the condition of elements of the system such as lubricating oil condition, for wear and debris monitoring as well as for deciding when to change the oil, spark plug condition, bearing and exhaust temperatures and so on. From such data can be deduced the mechanical and thermal "health" of the system, and probabilities of failure of components and sub-systems can be assessed and the assessments improved by taking into account the combined experience of a network of systems by tbis data being reported to and analysed by a computer in the remote control arrangement 21. This will help to avoid any foreseeable failure and so keeps the system operating at best achievable efficiency for all the time for which it is called upon to operate.

The electrical output of the generator is also monitored as to its power factor, phase voltage and current, and frequency. Gas consumption is also monitored. Programs in computers in the control arrangement 14 and the remote control arrangements 21 can evaluate the cost of generating the electricity and heating the building, and effect comparison with the costs of doing those things conventionally.

Another control arrangement function is engine governing and mains synchronisation.

The control arrangments 14 and 21 also incorporate an intelligent knowledge based system scheduling maintenance operation and predicting system or component failure.

The control arrangements 14 and 21 will be described in more detail below.

The system is, as illustrated, installed in a building with other heat generator means 22 to provide heat additional to that provided by the system. The system, however, is regarded as the "priority boiler" for the building (unless overridden) so that whenever heat is required electricity is generated at the same time. The other heat generator means 22 are also connected to the control arrangement 14 so as to be operated in conjunction with the combined heat and power system. As illustrated in Figure 1, the other heating means 22 are supplied with gas through a supply pipe 15a with a separate meter 16a. Both the heat recovery arrangement 13 and the heat generator means 22 can supply heat to the same heat distribution system such, for example, as a hot water circulating system to heat the building.

The generator 12 supplies electrical power via a meter 23, also connected to the mains supply, to the electrical distribution system 24 of the building.

The control arrangement 14 illustrated in Figure 1 comprises a microcomputer 31 based on, for example, the 16 bit 68000 series. The control system is contained in EPROM and the data in non-volatile RAM.

Sensors 32a, b, c etc are connected to the microcomputer 31 through a suitable interface unit 34 which scans and processes signals from the sensors and outputs to the computer digital signals representative of the sensor signals.

The sensors 32a, b, c etc sense the following variables :-

exhaust gas temperature
cooling water temperature
oil temperature
enclosure temperature
gas flow rate
oil condition (e.g. solids content, pH)
oil consumption/sump level
electrical power output, voltage, current
frequency
power factor
phase condition
exhaust gas oxygen content
presence/absence of mains electicity supply
spark plug condition

From this information, the microcomputer is programmed, in ways which will be well understood by those familiar with the art of computer control, to calculate :-

heat output of the heat recovery unit
specific fuel consumption (a measure of engine efficiency)
instantaneous and average energy efficiency

and cost saving

The variables are stored in the memory of the microcomputer for as long as may be necessary for operation of the system and computation of the various outputs and efficiencies, and passed on to the remote control arrangement 21 or dumped to a long term store or print-out for permanent record-keeping.

The microcomputer is also supplied with engine speed information, either directly via a tachometer or from the frequency sensor and is programmed to govern the engine to control generator frequency either to the mains frequency or to a preselected frequency for stand-alone operation. By comparing phase and frequency information for the mains and for the generator 12, the computer can adjust the engine 11 to synchronise the generator output with the mains supply for parallel operation.

The computer 31 also evaluates power demand (e.g. from voltage and power factor etc information) and controls, again in ways the computer control expert will readily appreciate, the engine 11 to match power output with demand by restoring sensed voltage and power factor to nominal levels. The computer 31 also controls the engine 11 start-up by outputting control signals to appropriate control devices.

Should any of the sensed variables exceed predetermined safety limits, the computer 31 is programmed to trip the unit out.

In the event of a shut down of the system in response to a safety trip, the programming causes the computer to review all of the variables and, if within limits (e.g. after some temporary abnormal condition) to attempt automatic restart and reconnection to the power distribution arrangement, re-synchronising, if necessary, with mains supply. This automatic reconnection may be attempted a prescribed number of times (depending on the reason for the shut down). If reconnection is not achieved, the control arrangement 14 abandons further attempts and passes a message to the remote control arrangement 21.

With more powerful programming and greater computational and analystical capacity the control arrangement 21 is able to devise some corrective action and instruct the arrangement 14 to attempt further reconnections using a modified start-up routine, or an alert can be given to repair or maintenance crew to repair any fault diagnosed or attempt manual reconnection or on-site investigation.

Performance data can be logged and analysed in the control arrangement 14 and 21 or either of them.

A computer 41 in the control arrangement 21 can house an expert system which has access to all stored data from the local control arrangements 14 of a plurality of combined heat and power systems and the control arrangement 21 can house a data base 42 for this purpose the information in the data base 42 being continually updated by the computer 41 with incoming information from the combined heat and power system 10 and others 10', 10" etc connected to the control arrangement 21. This expert system can be used to assess the likelihood of component failure (from initial data, which can be modified by data derived from actual performance of the components in the system) and thus direct preventative maintenance. The expert system can also schedule servicing of the head and power systems on the basis of utilisation - it will know, for example, the running times, oil conditions and so on of each location and plan oil changes and other servicing functions accordingly.

The expert system can also provide information on technical and commercial performance of the heat and power systems.

Heuristic programming enables the control arrangement 21 to develop new rules or algorithms and models and modify existing rules and models to deal with component failure, improve efficiency and so on. Mains electricity and fuel prices may also be fed in and used to compute the most cost-efficient utilisation of these energy sources. Different electricity tariffs may be input so that for example cheap night-time electricity can be used to best effect.

Whilst gas fuels have been described particularly, it will be understood that any other fuel such as oil, coal, wood, peat and so on may be used instead.

Claims

1. A combined heat and power network comprising a plurality of individual combined heat and power systems (10) for buildings connected to a common remote control arrangement (21), wherein:

each said system (10) comprises a prime mover (11) drivingly connected to an electrical generator (12) adapted to provide building electrical power, a heat recovery arrangement (13) connected to the prime mover (11) recovering heat therefrom and adapted to provide building heating, and a local control arrangement (14) adapted automatically to control the prime mover in response to heating demand;

each said local control arrangement (14) includes a memory and is adapted to monitor the condition of elements of the respective system and to store variables relating thereto in said memory;

and each local control arrangement (14) is

adapted automatically to shut down the respective system (10) in response to abnormal operating conditions indicated by said variables;

the remote control arrangement (21) being adapted to receive information representing said stored variables from the respective local control arrangements (14) and to evaluate said information so as to derive performance data and schedule servicing for the systems;

characterised in that the local control arrangement (14) is adapted automatically to attempt restart of the system following said shut down, and said remote control arrangement (21) is adapted to receive messages from said local control arrangements (14) following abandonment of such attempted re-start for evaluation and response by said remote control arrangement (21).

2. A network according to claim 1, characterised in that the generator (12) is adapted to be synchronised to an external a.c. electrical power supply (17).

3. A network according to claim 1 or 2 characterised in that the local control arrangement (14) is adapted automatically to shut down the prime mover (11) in the event building heat demand falls below a predetermined level.

4. A network according to any one of claims 1 to 3, characterised in that each system (10) is adapted to provide stand-by power in the event of external power supply interruption by the control arrangement (14) detecting such condition and automatically starting up the prime mover (11) and establishing connection of the generator (12) to power the building.

5. A network according to any one of claims 1 to 4, characterised in that each system (10) is adapted to response independently to building power demand and building heat demand.

6. A network according to claim 5, characterised in that each system (10) is operable to supply up to its maximum rated power output and simultaneously to supply less than the entire heat output associated therewith to building heating.

7. A network according to any one of claims 1 to 6 characterised in that each system (10) is adapted for connection to the remote control arrangement (21) by modem means (19) and a telephone link (20).

8. A network according to any one of claims 1 to 7, characterised in that each said local control arrangement (14) is adapted to control the respective said system (10) according to rules which can be changed by signals from the remote control arrangement (21).

9. A network according to any one of claims 1 to 8 characterised in that each said local control arrangement (14) is adapted to monitor lubricating oil condition.

10. A network according to any one of claims 1 to 9, characterised in that each said local control arrangement (14) is adapted to monitor spark plug condition.

11. A network according to any one of claims 1 to 10, characterised in that each said local control arrangement (14) is adapted to monitor temperatures of the system.

12. A network according to any one of claims 1 to 11 characterised in that each said local control arrangement (14) is adapted to monitor water temperatures associated with building heating.

13. A network according to any one of claims 1 to 12 characterised in that each said local control arrangement (14) is adapted to monitor prime mover exhaust system temperature.

14. A network according to any one of claims 1 to 13 characterised in that each said local control arrangement (14) is adapted to monitor flow rates of fluids used in the system.

15. A network according to claim 14 characterised in that each said local control arrangement (14) is adapted to monitor fuel flow rate.

16. A network according to claim 14 characterised in that each said local control arrangement (14) is adapted to monitor flow rates of water used to circulate building heat.

17. A network according to any one of claims 1 to 16 characterised in that each said local control arrangement (14) is adapted to monitor the electrical output of the system.

18. A network according to any one of claims 1 to 17 characterised in that each said local control arrangement (14) is adapted to monitor electrical pow r output.

19. A network according to any one of claims 1 to 18 characterised in that each said local control

arrangement (14) is adapted to monitor power factor.

20. A network according to any one of claims 1 to 19 characterised in that each said local control arrangement (14) is adapted to monitor phase voltage and current.

21. A network according to any one of claims 1 to 20 characterised in that each said local control arrangement (14) is adapted to monitor frequency.

22. A network according to any one of claims 1 to 21 characterised in that each said local control arrangement (14) is adapted to monitor the status of electrical control circuits of the system.

23. A network according to any one of claims 1 to 22 characterised in that each said local control arrangement (14) provides engine governing and mains synchronisation for said prime mover/generator arrangement.

Patentansprüche

1. Kombiniertes Heiz- und Stromversorgungs-Netzwerk mit mehreren einzelnen kombinierten, an eine gemeinsame Fernsteuerung (21) angeschlossenen Heiz- und Stromversorgungs-Systemen (10) für Gebäude, wobei:
jedes System (10) eine Antriebsmaschine (11) aufweist, die mit einem Generator (12) antriebsverbunden ist, der geeignet ist, Strom für Gebäude zu erzeugen, sowie eine zur Heizung von Gebäuden bestimmte Wärmerückgewinnungsvorrichtung (13), die mit der Antriebsmaschine (11) zur Rückgewinnung von deren Wärme verbunden ist, und eine örtliche Steuerung (14) zur Steuerung der Antriebsmaschine in Abhängigkeit von dem Wärmebedarf;
jede örtliche Steuerung (14) einen Speicher aufweist, der den Zustand der Elemente des jeweiligen Systems überwacht und Systemvariable in dem Speicher speichert;
jede örtliche Steuerung (14) derart ausgebildet ist, daß sie als Reaktion auf durch die Variablen angezeigte abnormale Betriebsbedingungen das jeweilige System (10) automatisch abschaltet;
und wobei die Fernsteuerung (21) von den zugehörigen örtlichen Steuerungen (14) Informationen bezüglich der gespeicherten Variablen empfängt und diese Informationen derart auswertet, daß Leistungsdaten abgeleitet und Wartungspläne für die Systeme erstellt werden;
dadurch gekennzeichnet, daß die örtliche Steuerung (14) derart ausgebildet ist, daß sie nach dem Abschalten automatisch eine Wiederinbetriebnahme des Systems versucht, und daß die Fernsteuerung (21) von den örtlichen Steuerungen (14) nach Abbruch der versuchten Wiederinbetriebnahme Meldungen empfängt, die in der Fernsteuerung (21) zwecks Rückmeldung ausgewertet werden.

2. Netzwerk nach Anspruch 1, dadurch gekennzeichnet, daß der Generator (12) mit einer externen Wechselstromversorgung (17) synchronisiert ist.

3. Netzwerk nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die örtliche Steuerung (14) die Antriebsmaschine (11) automatisch abschaltet, wenn der Wärmebedarf des Gebäudes einen vorgegebenen Wert unterschreitet.

4. Netzwerk nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß jedes System (10) in der Lage ist, eine Notstromversorgung zu liefern, wenn die externe Stromversorgung durch die Steuerung (14) unterbrochen wurde, diese Unterbrechung festzustellen und die Antriebsmaschine (11) automatisch zu starten sowie die Verbindung zu dem Generator (12) herzustellen, um das Gebäude mit Strom zu versorgen.

5. Netzwerk nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß jedes System (10) selbständig auf den Strom- und Heizungsbedarf eines Gebäudes reagiert.

6. Netzwerk nach Anspruch 5, dadurch gekennzeichnet, daß jedes System (10) bis zu seiner maximalen Leistung zu betreiben ist, wobei es gleichzeitig weniger als die gesamte Heizleistung für die angeschlossene Heizung des Gebäudes liefert.

7. Netzwerk nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß jedes System (10) an die Fernsteuerung (21) mittels eines Modems (19) und eines Telefonanschlusses (20) anzuschließen ist.

8. Netzwerk nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) das zugehörige System (10) nach Vorgaben steuert, die durch von der Fernsteuerung (21) gelieferte Signale veränderbar sind.

9. Netzwerk nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung des Schmierölzustandes eingerichtet ist.

10. Netzwerk nach einem der Ansprüche 1 bis 9, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung des Zustandes der Zündkerzen eingerichtet ist.

11. Netzwerk nach einem der Ansprüche 1 bis 10, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung der Temperaturen des Systems eingerichtet ist.

12. Netzwerk nach einem der Ansprüche 1 bis 11, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung der Wassertemperaturen im Zusammenhang mit der Gebäudeheizung eingerichtet ist.

13. Netzwerk nach einem der Ansprüche 1 bis 12, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung der Abgastemperatur der Antriebsmaschine eingerichtet ist.

14. Netzwerk nach einem der Ansprüche 1 bis 13, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung der Durchflußmengen von in dem System eingesetzten Flüssigkeiten eingerichtet ist.

15. Netzwerk nach Anspruch 14, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung der Durchflußmenge des Kraftstoffes eingerichtet ist.

16. Netzwerk nach Anspruch 14, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung der Durchflußmengen des Wassers eingerichtet ist, das in der Gebäudeheizung zirkuliert.

17. Netzwerk nach einem der Ansprüche 1 bis 16, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung der elektrischen Leistung des Systems eingerichtet ist.

18. Netzwerk nach einem der Ansprüche 1 bis 17, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung der Netzstromleistung eingerichtet ist.

19. Netzwerk nach einem der Ansprüche 1 bis 18, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung des Leistungsfaktors eingerichtet ist.

20. Netzwerk nach einem der Ansprüche 1 bis 19, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung der Phasen der Spannung und des Stromes eingerichtet ist.

21. Netzwerk nach einem der Ansprüche 1 bis 20, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung der Frequenz eingerichtet ist.

22. Netzwerk nach einem der Ansprüche 1 bis 21, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) zur Überwachung des Status der elektrischen Steuerschaltkreise des Systems eingerichtet ist.

23. Netzwerk nach einem der Ansprüche 1 bis 22, dadurch gekennzeichnet, daß jede örtliche Steuerung (14) die Maschinensteuerung übernimmt und die Synchronisierung der Antriebsmaschinen-Generator-Anordnung aufrechterhält.

Revendications

1. Un réseau combiné de chauffage et de fourniture d'énergie électrique, comprenant un ensemble de systèmes combinés individuels de chauffage et de fourniture d'énergie électrique (10) pour des immeubles connectés à une structure de télécommande commune (21), dans lequel :

chaque système (10) comprend un moteur (11) entraînant un alternateur (12) destiné à fournir de l'énergie électrique pour un immeuble, une structure de récupération de chaleur (13) reliée au moteur (11), récupérant de la chaleur à partir de ce dernier, et conçue pour effectuer le chauffage de l'immeuble, et une structure de commande locale (14) conçue pour commander automatiquement le moteur sous la dépendance de la demande de chauffage;

chaque structure de commande locale (14) comprend une mémoire et elle est conçue de façon à contrôler les conditions d'éléments du système respectif et à enregistrer dans la mémoire des variables concernant ces conditions;

et chaque structure de commande locale (14) est conçue de façon à interrompre automatiquement le fonctionnement du système respectif (10) sous l'effet de conditions de fonctionnement anormales indiquées par les variables précitées;

la structure de télécommande (21) étant conçue de façon à recevoir de l'information

représentant les variables enregistrées, à partir des structures de commande locale respectives (14), et à évaluer cette information de façon à élaborer des données de performances et un programme de maintenance pour les systèmes;

caractérisé en ce que la structure de commande locale (14) est conçue de façon à tenter automatiquement de faire redémarrer le système à la suite de l'interruption de fonctionnement précitée, et la structure de télécommande (21) est conçue de façon à recevoir des messages provenant des structures de commande locale (14) à la suite de l'abandon d'une telle tentative de redémarrage, pour que la structure de télécommande (21) évalue ces messages et y réagisse.

2. Un réseau selon la revendication 1, caractérisé en ce que l'alternateur (12) est conçu de façon à être synchronisé par une source d'énergie électrique alternative externe (17).

3. Un réseau selon la revendication 1 ou 2, caractérisé en ce que la structure de commande locale (14) est conçue pour interrompre automatiquement le fonctionnement du moteur (11) dans le cas où la demande de chaleur pour l'immeuble tombe au-dessous d'un niveau prédéterminé.

4. Un réseau selon l'une quelconque des revendications 1 à 3, caractérisé en ce que chaque système (10) est conçu de façon à fournir de l'énergie électrique de secours dans le cas d'une interruption du fonctionnement de la source d'énergie électrique externe, la structure de commande (14) détectant cette condition et faisant démarrer automatiquement le moteur (11) et établissant la connexion de l'alternateur (12) pour alimenter l'immeuble.

5. Un réseau selon l'une quelconque des revendications 1 à 4, caractérisé en ce que chaque système (10) est conçu pour réagir indépendamment à la demande d'énergie électrique de l'immeuble et à la demande de chaleur de l'immeuble.

6. Un réseau selon la revendication 5, caractérisé en ce que chaque système (10) est capable de fournir de l'énergie électrique jusqu'à sa puissance de sortie nominale maximale, et simultanément de fournir moins de la totalité de la chaleur qui lui est associée, pour le chauffage de l'immeuble.

7. Un réseau selon l'une quelconque des revendications 1 à 6, caractérisé en ce que chaque système (10) est conçu pour être connecté à la structure de télécommande (21) au moyen de modems (19) et d'une liaison téléphonique (20).

8. Un réseau selon l'une quelconque des revendications 1 à 7, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à commander le système respectif (10) conformément à des règles qui peuvent être changées par des signaux émis par la structure de télécommande (21).

9. Un réseau selon l'une quelconque des revendications 1 à 8, caractérisé en ce que chaque structure de commande locale (14) est conçue pour contrôler la condition concernant l'huile de lubrification.

10. Un réseau selon l'une quelconque des revendications 1 à 9, caractérisé en ce que chaque structure de commande locale (14) est conçue pour contrôler la condition des bougies d'allumage.

11. Un réseau selon l'une quelconque des revendications 1 à 10, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler des températures du système.

12. Un réseau selon l'une quelconque des revendications 1 à 11, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler des températures d'eau qui sont associées au chauffage d'un immeuble.

13. Un réseau selon l'une quelconque des revendications 1 à 12, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler la température du système d'échappement du moteur.

14. Un réseau selon l'une quelconque des revendications 1 à 13, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler des débits de fluides utilisés dans le système.

15. Un réseau selon la revendication 14, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler le débit de carburant.

16. Un réseau selon la revendication 14, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler des débits d'eau utilisée pour la circulation de la chaleur dans un immeuble.

17. Un réseau selon l'une quelconque des revendications 1 à 16, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler les caractéristiques électriques de sortie du système.

18. Un réseau selon l'une quelconque des revendications 1 à 17, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler la puissance électrique de sortie.

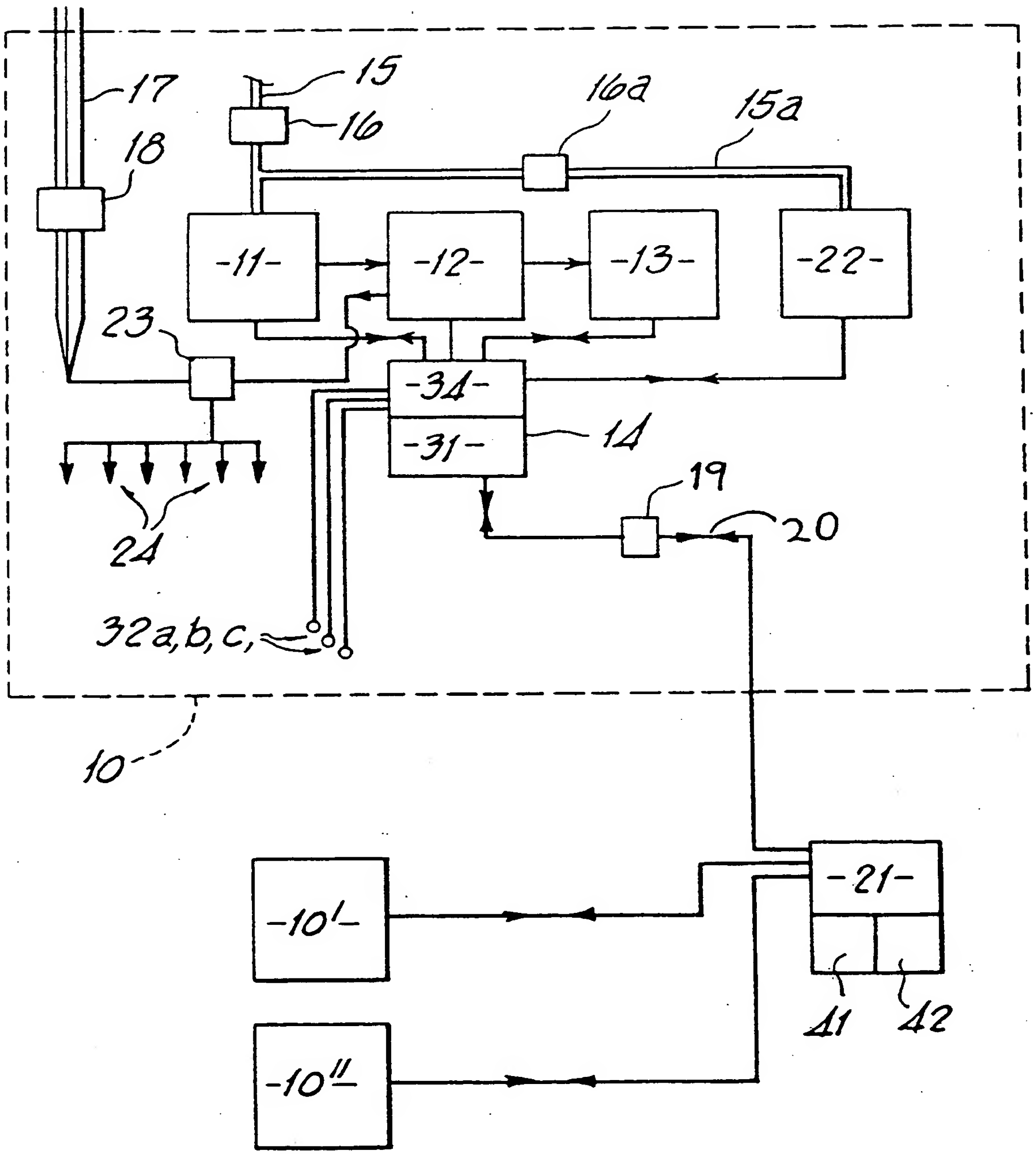
19. Un réseau selon l'une quelconque des revendications 1 à 18, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler le facteur de puissance.

20. Un réseau selon l'une quelconque des revendications 1 à 19, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler la tension et le courant de phase.

21. Un réseau selon l'une quelconque des revendications 1 à 20, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler la fréquence.

22. Un réseau selon l'une quelconque des revendications 1 à 21, caractérisé en ce que chaque structure de commande locale (14) est conçue de façon à contrôler l'état des circuits de commande électriques du système.

23. Un réseau selon l'une quelconque des revendications 1 à 22, caractérisé en ce que chaque structure de commande locale (14) assure la régulation du moteur et la synchronisation avec le réseau général de distribution d'énergie électrique pour la combinaison moteur/alternateur.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